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Investigating the determinants of contractor's construction and demolition waste management behavior in Mainland China

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ABSTRACT

The abundant generation of construction and demolition (C&D) waste presents a significant challenge to the sustainable development of the construction industry in Mainland China. As the implementer of construction activities, the contractor's C&D waste management performance plays an important role in C&D waste minimization. This paper aims to investigate the determinants of the contractor's C&D waste management behavior in Mainland China. The Theory of Planned Behavior (TPB) was selected as the basis of the theoretical model. In addition, three contextual constructs (i.e., economic viability, governmental supervision, and project constraints) were introduced, formulating the initial model. Based on the initial model, eight constructs were identified and seven hypotheses were proposed. A questionnaire survey was conducted to collect data and a Structural Equation Modeling (SEM) analysis was employed to test the proposed hypotheses. Results showed that the C&D waste management intention is not a significant determinant of contractor's C&D waste management behavior. The most important determinant is economic viability, followed by governmental supervision as the second most important determinant. Nevertheless, the construct of project constraints is an insignificant determinant for contractor's adoption of C&D waste management behavior. The research findings imply that, in Mainland China, the government, at this stage, plays an important role in guiding and promoting the contractor to exhibit better C&D waste management behavior.

1. Introduction

Construction and demolition (C&D) waste refers to the abandoned substances generated in the building and infrastructure activities of construction, renovation, and demolition (HKEPD, 2013; USEPA, 2013). According to the chemical characteristics, the materials involved in C&D waste can be divided into the categories of inert materials and non-inert materials. The inert materials (e.g., concrete, bricks, sub-soil) are the components that hardly participate in chemical reactions under common circumstances. The non-inert materials are readily involved in chemical reactions, such as rebar, and wood. As a by-product of construction activities, C&D waste is unavoidably produced and improper treatment can create negative environmental impacts.

The generation of C&D waste, however, can be minimized through effective management. In addition, C&D waste has a great possibility for producing useful resources after appropriate treatment. Dahlén and Lagerkvist (2010) claimed that wastes can be viewed as resources in the wrong place. Existing studies have shown that effective C&D waste management can bring economic benefits to the construction project stakeholders (Coelho and de Brito, 2013; Zhao et al., 2010). To give a holistic picture, Lu and Yuan (2011) divided C&D waste management practices into hard technical measures and soft managerial measures. The hard technical measures refer to the environmentally friendly construction technologies, such as prefabrication, steel framework, recycled aggregates, etc. The soft managerial measures comprise regional economic instruments such as waste disposal charging scheme and on-site management measures (i.e., on-site sorting).

Echoing with these academic studies, C&D waste management measures are also recommended in industrial guidelines. For instance, C&D waste management performance is a crucial assessment component within green building rating systems. In terms of the green building rating systems in the US, UK and China, the weight of C&D waste management is 10%, 8.16% and 11.84%, respectively (Wu et al., 2016). Effective C&D waste management is also considered to be essential for achieving the visions of

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landfill space conservation, environmental impact reduction, job opportunity creation, and project expense reduction (USEPA, 2013). It is of importance, therefore, to urge construction stakeholders to promote and implement effective C&D waste management.

In construction projects, there are a number of key elements involved, such as manpower (human beings), machines, materials and money. The most important element is considered to be the human beings who participate in direct construction activities (Wu et al., 2011). This is because human beings are the only ones able to connect all the other resources together so as to achieve the final project objectives. However, in the current circumstance, though C&D waste management regulations have been set and mature technologies have been developed, C&D waste management practice on real-life projects is regarded as inadequate (Ajayi et al., 2015; Wu et al., 2015). It is, therefore, necessary to investigate the determinants which can promote the adoption of C&D waste management measures.

This paper aims to investigate the determinants of contractor's C&D waste management behavior in Mainland China. Mainland China is focused in this study because it contains the most dramatic and the largest construction market in the world. Construction spending in Mainland China reached almost US $1.8 trillion in 2013 (Sito, 2014). It was estimated that the C&D waste generation was about 1.13 billion tons in 2014 (Lu et al., 2016). Despite the enormous amount of C&D waste, the corresponding management is not mature at present (Lu and Yuan, 2010). Since the contractor is the direct C&D waste producer and waste management implementer on real projects, this research study selected the contractor rather than other stakeholders as fundamental in this investigation.

2. Literature review

This section presents the existing studies on contractor's attitude and behavior towards C&D waste management. The Theory of Planned Behavior is introduced subsequently. Based on the literature review, the research gap and innovation of this research are clarified at the end of this section.

2.1. Attitude and behavior research on C&D waste management

The research on investigating construction stakeholders' attitudes and behavior towards C&D waste management has been conducted in existing studies. Lingard et al. (2000) found that the managerial staff in a large Australian contracting organization had a less positive perception of the waste management climate than the site workers. The managerial staff regarded cost, time and quality objectives are more important than potential environmental issues. In Malaysia, Begum et al. (2009) investigated the factors affecting contractor's attitude and behavior regarding waste management and found that a positive attitude towards waste management can lead to satisfactory behavior. Echoing with Begum et al. (2009), Al-Sari et al. (2012) examined how the local contractor waste management attitude and behavior is influenced in the occupied Palestinian territory. The authors observed that in the absence of a regulatory framework, the C&D waste management behavior of the local contractors was mostly driven by direct economic considerations. In Europe, the influencing factors of C&D waste management behavior were investigated as well. For example, Calvo et al. (2014) tested the influence of governmental policies (i.e., economic incentives and penalties) in recycling of C&D waste aggregates in Spain. Sun et al. (2015) investigated the waste management practices and opinions of small builders in the UK. From the literature review, it can be seen that the contractor's attitude and behavior towards C&D waste management have been investigated worldwide. In the existing studies, there is a common assumption that the contractor's C&D waste management attitude is equal to the actual C&D waste management behavior. However, according to the attitude and behavior theories, it is inappropriate to assume an attitude towards behavior simply determines the final behavior.

2.2. Theory of Planned Behavior

In the Theory of Planned Behavior (TPB), there are three main predictors towards a particular "behavior". They are (1) attitude towards behavior (i.e., favorable or unfavorable evaluation of the behavior), (2) subjective norm (i.e., the perception of the expectations of relevant others), and (3) perceived behavioral control (i.e., perceived own capability to successfully exhibit the behavior). The TPB framework is illustrated in Fig. 1.

In the presented framework, it can be seen that an individual's behavior is directly affected by his/her behavioral intention. The behavioral intention is directly affected by his/her attitude, subjective norm, and perceived behavioral control. The more positive the personal attitude, the more support from relevant persons, and the more perceived the autonomic control, the more possible that the individual has corresponding behavioral intention and the actual behavior. The TPB has got successful applications in many research fields, such as internet purchasing (George, 2004), green hotel choice (Han et al., 2010), doing physical exercise (Carmen Neipp et al., 2015). However, Ajzen (1991) admitted that the actual behavioral control was more important than the perceived behavioral control, because the actual control contains the feasibility of opportunities and resources which is the prerequisite of performing behavior. The actual control is different from the perceived behavioral control because the individual's perceived behavior cannot be exact. For example, a student has a large extent of controlling himself to attend a class; however, his actual behavior may be affected by unanticipated accidents (e.g., snowstorm or traffic accident). In such situation, the particular behavior cannot be executed even though the individual has strong perceived behavioral control. To solve this problem, contextual constructs were suggested to be added based on the basic TPB model (Chu and Chiu, 2003; Guagnano et al., 1995).

2.3. Research gap and innovation in this study

From the above literature review, it can be identified that there is a research gap that the contractor's C&D waste management behavior has not been investigated based on the attitude and behavior theories. The objective of this study is to investigate the determinants of C&D waste management behavior based on a mature attitude and behavior theory (i.e., TPB). The innovation of this study is that contextual constructs (i.e., governmental

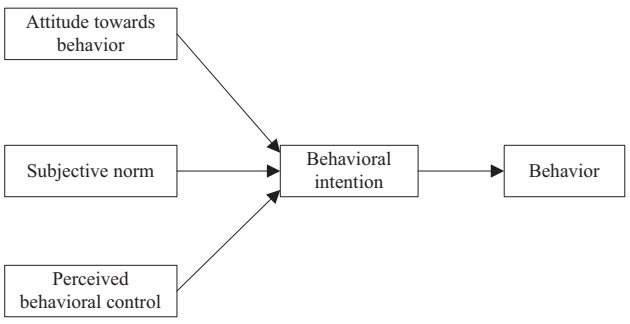

Fig. 1. Theory of Planned Behavior (Ajzen, 1985).